CASSAVA: the potential is enormous

Cassava — also known as manioc and tapioca — was until recently one of the world's neglected food crops. DAVID SPURGEON, director of the IDRC's Publications Division, reviews recent research efforts that are attempting to develop the full potential of this versatile tropical root crop, efforts that could triple the present yield.

Four years of work and some $4 million worth of support from the IDRC and the Canadian International Development Agency have produced some remarkable results from a research program on cassava, the staple diet of some 200 to 300 million people throughout the world.

As those involved in the program prepare to carry it into its second phase, they are planning to disseminate these results and to test and adapt their newly-developed techniques of production and utilization in as many cassava-producing countries as possible.

The achievements include:

- Identification of varieties that yield 45 tons per hectare in Colombian farmers' fields – more than four times the national average yield of 10 tons per hectare.
- Control of bacterial blight and identification of resistance to many important diseases.
- Identification of varieties resistant to many of the major insects.
- Introduction of biological control of important pests.
- Development of methods of rapid propagation.
- Development of tissue-culture techniques by which to produce disease-free material.
- Improved methods of storage.

Cassava is a tropical root plant that originated in the Western hemisphere and is thought to have been first cultivated agriculturally either in Northeast Brazil or along the Colombian-Venezuelan coast. There it appears to have been the first staple food crop in settled agriculture in the Western hemisphere.

Because it grows only in tropical and sub-tropical areas and is highly perishable, cassava has received little attention from agricultural research workers. In fact, prior to 1971, the total annual global expenditure for research on cassava appears to have been no more than about $200,000, and few scientists could be found who had studied the crop.

Nevertheless, cassava has enormous potential. Under experimental conditions, it appears to be capable of producing more energy per land unit per year than any other known staple food crop. The highest recorded yield of cassava provides more than 20 percent more calories per hectare than the highest recorded yield of maize, which is generally considered the highest yielding cereal.

Besides its value as a food crop for humans (which is limited by the fact that its protein level is low), cassava has long been exported for its starch content, which possesses characteristics of special interest to the food, paper and chemical industries. In recent years there has also been a new interest in cassava because the dried and pelleted root can be used successfully in animal rations, with an energy value almost identical to that of corn: in the last decade, imports by the European Economic Community have more than tripled, largely for this reason.

Cassava is produced in more than 80 countries, but two-thirds of world production takes place in only five – Brazil, Indonesia, Zaire, Nigeria and India. It is generally grown as a subsistence crop, and is valued because of its tolerance to drought, its ability to grow in poor soils, and its resistance to weeds and insects. It can be planted and harvested in any season and can be left for long periods in the ground without harvesting, which makes it useful as security against famine. In 1974, the value of cassava exports exceeded $200 million, and a study published by the IDRC (IDRC Monograph 020e, *Cassava utilization and potential markets,* by Truman P. Phillips), indicates that by 1980 the value of these exports is expected to increase to possibly $500 million annually.

The IDRC's cassava research program began almost as soon as the Centre got underway. At this time, CIDA began discussions to support a cassava program (along with a related swine nutrition program) at the International Centre for Tropical Agriculture (CIAT) in Colombia. At the same time, CIDA requested the Centre to manage both the funds that it proposed allocating to CIAT over a five-year period, and funds it planned to designate for related basic research in Canadian institutions. In September, 1971, a series of contracts were signed between CIDA, CIAT and the IDRC.

The IDRC's approach to the program was, first, to establish a dialogue between CIAT and selected Canadian institutions, and second, to try to find scientists who either were working on, or had worked on, cassava, in order to obtain their help. The Centre found that few scientists of high calibre had ever worked with cassava, and most of the prominent ones were either retired or no longer active in the field. Nevertheless, enough were found (about two dozen) to hold a workshop at CIAT, review the state of the art in the various specialties, relate this to the draft program, and set up an advisory committee to assist IDRC in managing the program.

Since then, six more workshops have been held on various aspects of cassava in different parts of the world: one each on Common Cassava Mosaic in Nigeria in 1972; on Chronic Cassava Toxicity in London in 1973; on Global Market Prospects for Cassava in Ottawa in 1973; on Processing and Storage Problems in Thailand in 1974; and on the Development of a Standard International Testing Program at CIAT in 1975; and on a Standard International Testing Program, also in 1975 (each of which resulted in a publication).

A complex network of relationships has grown up between a wide range of research organizations throughout the world as a result of the cassava program, and the total effort is a collaborative one. The IDRC has played a major role in catalyzing these efforts. The whole program is interdisciplinary.

Some of the most important work carried out so far has involved classification of the characteristics of the germ plasm collection CIAT had gathered before the program began. Researchers have found a wide range of interesting and valuable characteristics among the 2,300 varieties. Some varieties have shown considerable disease and pest resistance. A good deal of variation exists in root yield between varieties, and this has been related to the form of the canopy of leaves in different plants.

The researchers have identified some 20 to 30 key characteristics exist in the germ plasm collection, and they will endeavor ultimately to bring them all together into a single "super-plant" model variety, or ideotype.

Along with such work, studies have been carried out on physiological and agronomic characteristics, such as the opitmum plant leaf density, best fertilizer application and harvesting time. One survey, carried out on 300 small farms in five different zones of Colombia, has shown some of the reasons why farm yields currently are so low. Feedback from this farm study and others in Nigeria, Brazil and Thailand will be used to orient future research activities.

Present indications are that while farmers' yields usually lie between 10 and 12 tons per hectare in Colombia, commercial scale yields of more than 40 tons per hectare have been achieved experimentally, and small plot results have gone as high as 66 tons per hectare per year.

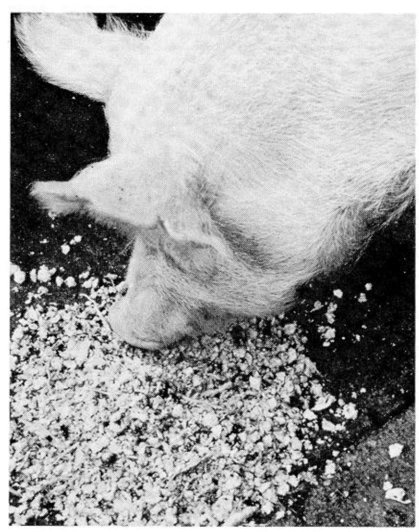
Some success has been achieved during the past two years in a project to produce plants free from symptons of cassava mosaic, using tissue culture techniques. An important part of the work, carried out at the National Research Council of Canada's Prairie Regional Laboratory in Saskatoon, was the identification of an appropriate mixture of three hormones to initiate development of roots and shoots. The technique may provide a means of "cleaning up" diseased stock in order to move desirable germ plasm about freely on an international basis, or for commercial distribution. It may also provide a tool for cassava researchers to produce disease-free stock for research purposes, especially in areas where virus disease is widespread.

The technique offers considerable promise if sympton-free plants can be shown to be disease-free plants, but pending identification of the cause of mosaic this cannot be stated with any degree of certainty.

In 1972, a program was begun at CIAT to identify the important diseases of cassava and the losses they cause, and to develop methods of control. When the program began, there was little reliable information available on cassava diseases, except for cassava mosaic disease. In fact, it was generally believed that these diseases were of no great importance.

Scientists at CIAT in Colombia are attempting to develop cassava varieties that are resistant to bacterial blight.

The horn worm is one of the major pests that attacks cassava.



Cassava also has potential as a low cost source of animal feed.

Photos: Neill McKee

But about that time, a major outbreak of cassava bacterial blight (CBB) occurred, dispelling this notion once and for all. As a result of work done in the research program, adequate methods for elimination of this disease were developed, and the CIAT farm itself is now completely free of CBB. Techniques were also developed for screening plant types for resistance to CBB, and several resistant varieties have been identified. Varieties resistant to a number of other diseases have also been identified.

Also successful was the work on parasites of cassava. So successful was it with two varieties – the horn worm and the shoot fly – that work on the CIAT farm has become restricted because of a scarcity of the pests. Interestingly, the situation apparently developed when CIAT stopped using insecticides against the parasites, thus allowing their natural predators to return and attack them. By contrast, continued spraying on a neighboring experimental farm appears to have eliminated the natural predators, resulting in a higher incidence of the pests, particularly the horn worm.

A project at the University of Guelph has succeeded on the laboratory scale in developing a low-cost, low-technology system for production of microbial protein from cassava, for use in an animal feed at prices competitive with ordinary feeds currently used. Cooked cassava roots are inoculated with a fungus, which then grows on the cassava and forms protein. This protein then enriches the cassava mash to produce a feed for animals. The original protein content of cassava is only about one percent on a dry weight basis. The Guelph project has produced a product with 10 percent protein.

An additional advantage of the process is that the microorganism grows well at tropical temperatures. Consequently, unlike many similar proposed processes that rely on organisms that thrive only under temperate conditions, this process does not require costly mechanical refrigeration. Field trials with the fermentor required for the process will soon be carried out in Colombia.

Training programs have not been neglected in the cassava program. For example one enabled a Sri Lankan horticulturist to visit CIAT. Another trained 20 Brazilians during four weeks at CIAT. Some of the participants in the latter course will be concerned with development of a national cassava research program in their own country. Several other Latin American countries have also been involved in plans for a regional network of cassava research. Discussions have begun with India, Malaysia, the Philippines and Brazil to assist these countries in establishing strong national programs; programs concentrating on cassava in animal feed began in Thailand and Nigeria early in 1975, and a project in India has been approved.

Thai women spreading cassava chips to dry in the sun.

A program to breed improved cassava varieties and carry out farm trials, established by the Malaysian Agricultural Research and Development Institute in March, 1975, will also provide training facilities for scientists and technicians from Malaysia and neighboring countries.

The intention for the next phase of the cassava program is to establish cooperative research, demonstration and training programs in two continents: Latin America and Asia. Personnel from CIAT and IDRC will act as research coordinators, and the improved plant materials and agronomic systems will find their way back to CIAT, where information will become available to interested people throughout the world through a Cassava Documentation Centre that has been set up with the help of the Centre's Information Sciences Division. The Documentation Centre is attempting to put together in a single bibliography all the known scientific literature on this valuable crop.

The IDRC will be publishing in early 1976 a comprehensive review entitled "Cassava: the development of an international research network," by Barry Nestel and James Cock (IDRC-059e). The manuscript of this yet unpublished book was used freely as a source document in the preparation of the above article.

Trinidad: scientist removes cassava mites from leaves for examination — the mites are a major insect pest.